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CONTENTS.

ERRATA.

VOLUME 8, NO. 4 DECEMBER, 1937.

P. 2, para. 4—For " infection," read " infectious."
P. 34, Title.—For " Taveuni Islands," read " Taveuni Island."
P. 34, para. 3—For " first (1)," read " (2)."
P. 35, References.—For " (1), (1), (3)," read " (1), (2), (3)."

AGRICULTURAL JOURNAL

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VOL. 9.] MARCH, 1938. [NO. 1.

EDITORIAL.

THE first issue of the *Agricultural Journal* for the year 1938 is a departure by the inclusion of advertisements. It is hoped that readers will consider purchasing some of their requirements from the various firms which advertise a wide range of agricultural products and a variety of articles of need to the planter on his estate.

One of the most outstanding events since publication of the last number was the flood which is estimated to have caused a loss of 50 per cent. of the sugar cane in Ba Province of Viti Levu. Although the water did not reach to within seven feet of the 1931 level, it none the less caused severe flooding of shops and houses in the Voroka area and temporarily interrupted telephonic communication between Lautoka and Tavua. Flooding was also experienced in Nadroga and Nadi Provinces.

An article in this issue which calls for special mention is that on banana growing in Australia which gives an excellent account of the whole industry in the Commonwealth and serves to show how quarantine measures, if efficiently applied, can result in virtually resuscitating an industry which was severely threatened by a disease spread by a green fly or aphid. It is interesting to note that pyrethrum dusting is never practised against the scab moth.

A Colony such as Fiji with its large exports of bananas and oranges to Australia, New Zealand and Canada cannot but be vitally interested in the technique of shipping fruit. The article on the subject of cool storage of soft fruits is therefore of great interest and the value of having pre-cooling plant installed has been appreciated already by Rarotonga in the Cook Islands Administration.

The tree *Leucæna glauca*, locally known as "vaivai," has not been exploited as much as it could and the article on this legume should draw attention to its possibilities. It is always of interest to follow the changes in opinion which may occur over a number of years and the reference in the *Agricultural Journal*, Vol. 3, No. 3, 1930, page 113, shows "vaivai" to be somewhat troublesome on rich river-flats in Ba Province as it encroaches rapidly on cultivated land and has to be eradicated. However, its value as firewood, fodder for cattle, soil enriching, shade for field crops and use as windbreaks should outweigh its possible harmful effects in cultivated areas.

SUMMARY OF METEOROLOGICAL OBSERVATIONS RECORDED AT SUVA, 1937.

Month.	Temp. in ° F.		Humidity percentage.		Rainfall in inches.	
	Mean Max.	Mean Min.	Max.	Min.	Total.	Difference from average
January	88·9	76·6	95	55	8·78	−2·73
February . ..	87·9	76·8	96	58	8·29	−3·07
March	86·2	75·6	99	58	17·53	+2·71
April	85·9	75·2	91	58	12·13	−0·19
May	82·4	73·1	96	54	16·49	+5·91
June	82·1	71·6	98	58	2·23	−4·15
July	78·5	69·7	99	58	4·76	−0·51
August	78·6	69·5	99	54	11·46	+3·31
September ..	78·5	69·2	97	47	6·95	−0·62
October	81·6	72·2	96	53	6·63	−2·23
November. ..	83·6	73·3	97	51	5·87	−4·27
December ..	84·8	74·0	97	52	5·51	−6·99
	....	....	....	....	106·63	....

The above data are taken from the observations made by the Harbour Master at Suva Wharf and published in the *Fiji Royal Gazette*. The site and exposure of the instruments are "conventional" and readings are taken at 8 a.m. and 2 p.m. local time.

The rainfall for the year 1937 was 12·79 inches less than the average for 52 years (119·42) and 23·30 inches below 1936 (129·93). July is usually the driest and March the wettest month of the year.

These are typical figures for the wet zone on the windward sides of the main islands; the leeward side in the dry zone has an average rainfall of 69 to 82 inches of which up to half falls in the first three months in the year.

—R.J.A.W.L.

NOTES ON THE BANANA INDUSTRY IN AUSTRALIA.

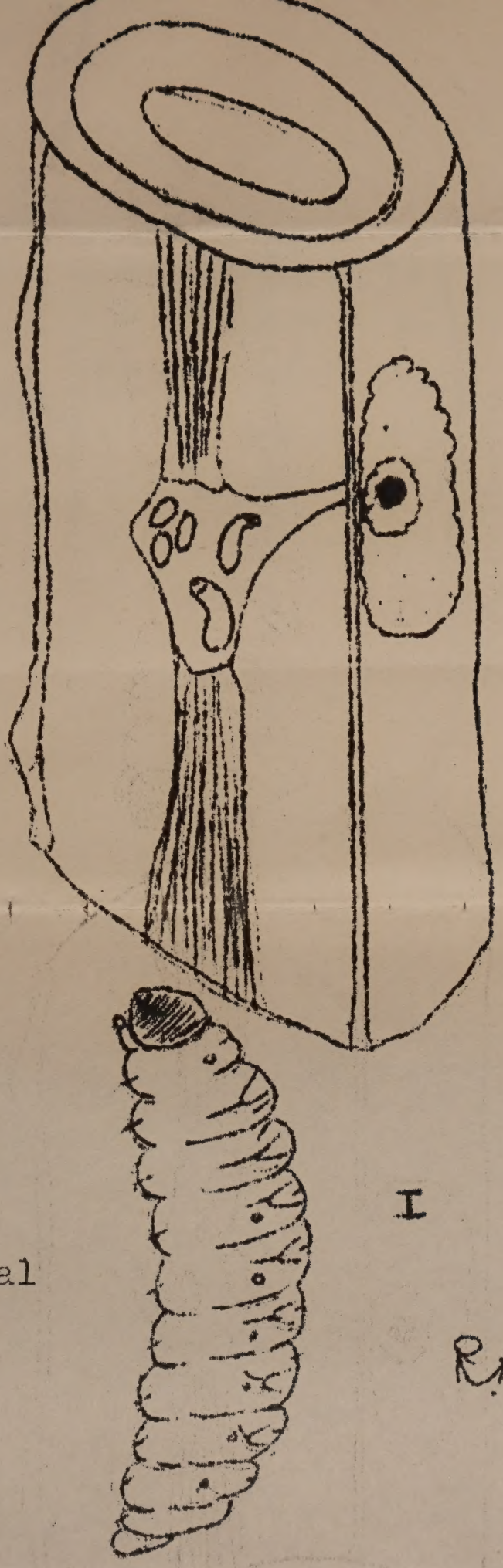
By
B. E. V. PARHAM, M.A.,
Agricultural Officer Central and Plant Pathologist.

During October 1936, the writer visited Australia with a view to studying at first-hand the cultivation of certain tropical crops, with special reference to disease control methods.

Although some attention was given to conditions affecting the production of citrus fruits, tobacco, passion-fruit, pineapples, and to forestry questions, most of the time available was devoted to bananas. Owing to the fact that the visit was limited to a period of only three weeks, it would have been quite impossible to accomplish very much without the assistance and co-operation of the officers of the New South Wales and Queensland Departments of Agriculture who gave up much time and conducted the writer to the localities of the greatest interest.

The following brief account has been prepared as summarizing the observations made in connection with the cultivation of bananas and the control of disease in these two States.

The most striking fact regarding the banana industry in Australia is the great development which has taken place during the past nine years.



Xyleborus morstatti Hag.

Damaged twig with grubs.

Grub.

(Line shows actual size.)

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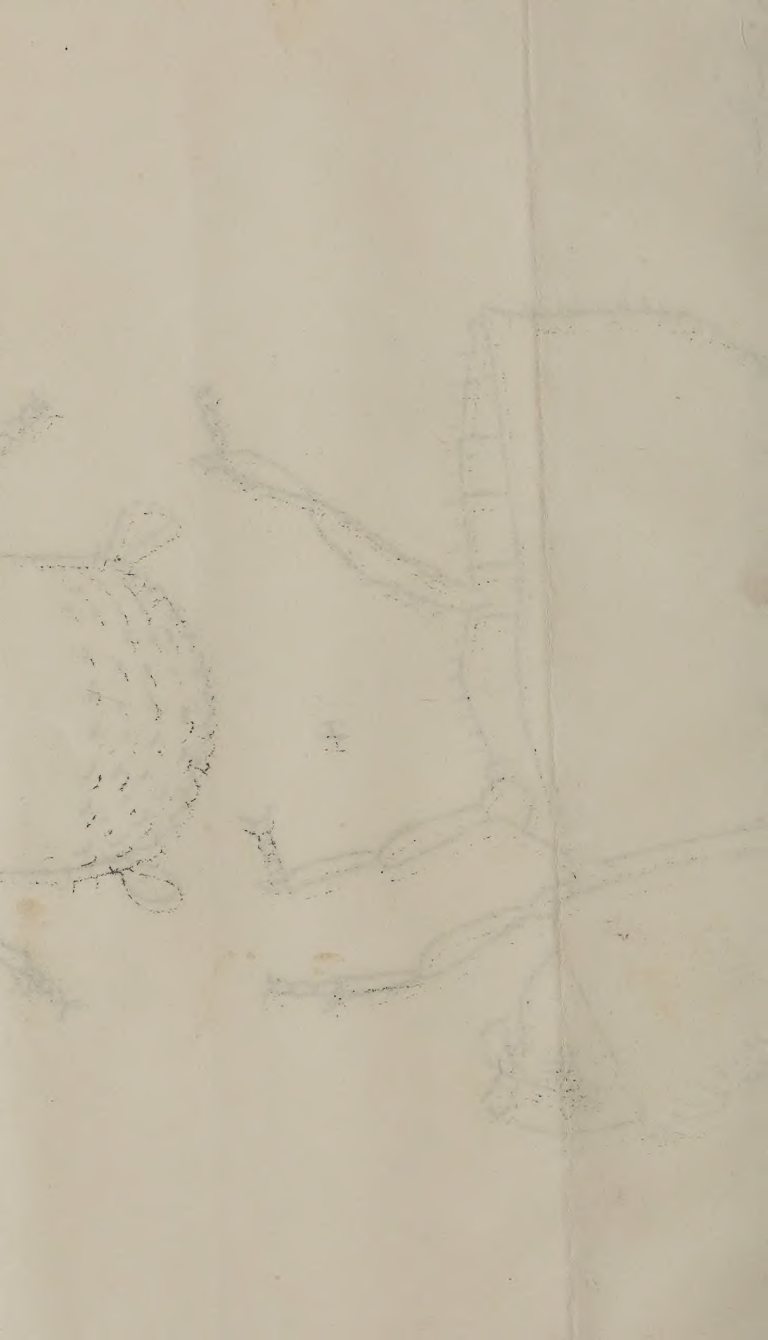


Prior to 1927, the banana areas of northern New South Wales and of Queensland was completely devastated by the Bunchy Top virus disease and the industry practically annihilated. A Banana Control Board was established in 1927 and a Research Division began investigations which resulted in the discovery by C. J. Magee of the cause of the disease and the method of transmission by means of the insect vector, *Pentalonia nigronervosa*. Regulations were drawn up for the adequate control of this disease, with the result that in 1936 Queensland had 17,000 and New South Wales 16,000 acres of productive banana plantations.

The production of bananas for the year ending July, 1936, is given in the following table:—

Tweed River	610,939	cases.
Brunswick	170,548	,,
Richmond River	222,982	,,
Copp's Harbour	252,140	,,
New South Wales total	1,256,609	,,
Queensland total	281,372	,,
Total production	1,537,981	cases.

The essential point is that this production is maintained only by strict adherence to the Banana Disease Regulations which are carried out under the supervision of inspectors in New South Wales and of Agents of the Banana Control Board in Queensland. The essence of the regulations is the early diagnosis of infection and the immediate eradication of the diseased stools. Responsibility is delegated to the grower, who, under the regulations, must in time become a good grower insofar as the cleanness of his plantation in concerned.

Every year an aggregate of many thousands of acres is eradicated on account of disease or falling-off in productivity due to age or poor soil. The following are brief notes on the conditions in the two States producing practically all the bananas marketed in Australia. In Western Australia a few bananas are grown in the Carnarvon district but fruit is imported also from Java.

New South Wales.—The industry is localized in the North Coast Districts around the Tweed River, with Murwillumbah as the centre. There are 5,800 acres of bananas in the Tweed area out of a total of 16,226 acres for the whole of New South Wales. In 1926 the whole of the Tweed River area was devastated by Bunchy Top virus and the industry ruined. With the putting into effect of the regulations in 1927, 1,500 acres were planted, followed by a steady increase to date. It is hoped to maintain 16,000 acres per annum—many of the plantations continuing to produce marketable fruit for 6 to 8 years. The average rainfall is 59 inches per annum; frosts occur in the low-lying areas and the average winter temperatures are 40° to 45° F.

Methods of cultivation do not require detailed description; for the main commercial varieties the hillslopes are preferred and plantations may be seen on soils from varying light clay loam to red volcanic. Exposure to sea breeze and air is considered desirable. For bananas, virgin "scrub" land (*i.e.*, rain forest land) is more productive than the "forest" (*i.e.*, Eucalypt land) or the grass lands. Nevertheless, some excellent crops are being obtained from old grass land areas, with the addition of suitable fertilizers.

Plantations vary in size from 3 acres to 20 or even 100 acres in extent and are kept clean-cultivated by means of hoeing or by the use of weedicides. Common weed-killers in use for this purpose are arsenic pentoxide, arsenite of soda and proprietary weedicides which are applied with a "Rega" knapsack sprayer (one-man outfit). Often owing to the extreme steepness of the land this clean cultivation results in the loss of surface soil and up to the present time contour planting and terracing has not been practised although the obvious necessity for conservation of the soil is drawing some attention to the matter. Erosion of the bare soil is heavy during rains but green cover crops are definitely not favoured as during dry weather they are said to rob the bananas of soil moisture.

Six years is probably the average life of a plantation, after which the land goes back to grass or lantana. There are many thousands of acres of good land available for further planting and much of the land formerly under bananas but abandoned on account of Bunchy Top disease is being brought back into cultivation.

Fertilizers are used extensively, common mixtures being:—

(1) 2 lb blood and bone and 1 lb sulphate of potash per stool (10 cwt. per acre);
(2) Nauru Island phosphate—1¼ lb per stool;
(3) B.P. banana manure—4 lb per stool per year in three applications.

The rate of development of the bunches varies from 3½ to 8 months according to season. The bunches thrown in April are not cut until September (*i.e.*, 5 months, and some on south slopes at high altitudes take 10 months.) The bunches thrown in the period October to December are frequently very irregular. Hands with fruit 3 inches long to 8 inches long occur and frequently part of these bunches is unmarketable.

Grass land is ploughed several times and well worked, the plants being spaced 10 feet by 11 feet, and clean-cultivated, the only mulch being the trash from the bananas. In one area of red volcanic soil (old grass land), plants four years old were seen in excellent condition. At the first cutting 300 cases per acre were obtained. The pruning system followed allowed for two plants and two followers. Pruning is strictly attended to as essential for the production of good bunches and also for the adequate control of disease and pests. Fruit on the red volcanic soil does not grow large nor fill out well. Many of such areas are fully exposed to the wind, no wind-breaks being provided. Plantations in the gullies are frequently surrounded by natural windbreaks, scrub or Lantana second growth. Many areas are exceedingly stony, the surface of the soil being covered with large boulders. All the soils planted to bananas are on the acid side.

A condition known as Choke Throat (Fig. 4) is characteristic of the Cavendish variety and results in the deformation of the bunch, portion of which is variety and results in the deformation of the bunch, portion of which is frequently not marketable. The condition is very like a typical case of Bunchy Top virus disease but the diagnostic symptoms of that disease are not present. It is evident that in this area the climatic conditions are not completely suitable for this crop.

Costs.—The costs of production vary with the type of soil and the situation; but the following are given as average figures:—

Cost to bring up to bearing (includes all costs)	.. ..	£35 to £40 per acre.
Cost of maintenance (minimum)	..	£30 per acre per annum.

Fig. 1—" Sigatoka " disease. Veimama variety, Fiji.

Fig. 2—" Sigatoka " disease. Cavendish variety, Tweed River, N.S.W., Australia.

Fig. 3—" Mons Marie," Veimama variety, S. Queensland.

Fig. 4—Cavendish Banana affected by " Choke Throat."

Fig. 5—"Mons Marie" (Veimama). Plantation showing method of pruning and trashing, S. Queensland.

Fig. 6—Corner of banana plantation at Austinville, S. Queensland.

Fig. 7—Ploughing pasture land for banana planting, Carrumbin Valley, S. Queensland.

The initial costs may be reduced if a man uses his own suckers, otherwise the cost is from 30s. to 40s. per hundred for Cavendish and £2 for. Veimama

Maintenance costs include:—

Borer control, £7–£8 per acre.
Bunchy Top control, £7–£8.
4–6 chippings with hoes, £1–£1 10s. per annum.
De-suckering, cutting, packing, &c., £15–£18.
Estimated cost of production per case = 4s.

Freights.—Sydney, 2–3d.; Melbourne, 3–5d.; Adelaide, 4–5d.

It costs 9s. gross per case to market the fruit, and the market prices, ranging from 14–18 shillings per case, give 5s. to 9s. per case profit to the grower which is considered satisfactory. The first cutting usually gives 200 cases per acre.

Practically all fruit grown is marketed, even from bunches which fall from the stem of diseased plants but it is strictly graded:—Sizes, 5½ 6in. by 4 in (very small); sevens, 6½–7 in.; eights, 7½–8 in.

Queensland.—In this state the banana areas are all now in the south, near the Border of New South Wales. Prior to 1927 these lands became unproductive owing to infection with Bunchy Top virus. The centre of the industry then moved up to the tropical north: but with the control of that disease has again become established in the south. Conditions are generally somewhat similar to those in the Tweed River area of New South Wales, but large areas of new scrub land have been recently planted at Austinville, Currumbin (Figs. 6 and 7) and elsewhere. Moreover, Queensland growers have during the past two years planted extensive areas of the so-called "Mons Marie" (Figs. 3 and 5) variety, which is identical with the Fijian "Veimama," grows extremely well and produces a very promising bunch although the individual fruits do not develop fully. There are approximately 17,000 acres of bananas in the State and disease is generally extremely well controlled.

The main diseases investigated in the field were:—Bunchy Top virus disease; *Cercospora* leaf spot; Cigar End; Black Finger; Panama Disease; Corm-rot; Leaf-fall; Yellow Leaf Spot and Anthracnose. Of these it may be said that Bunchy Top virus disease is the most important; although in many plantations the condition of the plants is identical with that seen in Fijian "Sigatoka" disease, *i.e.*, failure of the foliage-crown, collapse of the main stalk and dropping of the bunch (Figs. 1 and 2). *Cercospora* leaf-spot is recognised but is nowhere severe except in North Queensland.

Bunchy Top virus disease.—This virulent disease transmitted by the insect vector *Pentalonia nigronervosa*, is rapidly epidemic and if unchecked soon destroys a plantation. No resistant strains of the Cavendish banana are known, and the banana industry depends entirely on the plant sanitation campaign carried out under the regulations of the Bunchy Top Control Board which controls the movement of plants, compels the eradication and destruction of infected stools and limits the areas of any one grower. Under the regulations, a grower must obtain a permit to plant bananas and permits to move suckers. Inspectors carry out the regulations for the control of Bunchy Top and weevil borers, cultivation and control of weeds. Prosecutions follow neglect of any of the above or of cultivation for longer than six months. If 20 per cent. of the plants in any one area are diseased, an eradication notice is issued for a part or the whole of the plantation on the grounds that such an area is a menace and beyond control. Inspectors also advise with regard to general cultivation, packing, transport, wire-ways and

manures. Permits to move suckers are given only for plants known to be free from Bunchy Top virus and borers. A history card is kept of each plantation. The use of borer-free and disease-free suckers is compulsory.

The diagnosis of Bunchy Top virus has been studied intensively and it is now possible for it to be detected in an extremely early stage. Aphids are exceedingly plentiful in the plantations so that immediate action is essential. A plant infected with the virus will fail after the production of five leaves after the first signs are visible (*i.e.*, in about two months). Such a plant will never bear fruit and no recovery is known. The disease is only insect transmitted and its spread from plant to plant is exceedingly rapid. Recently, above Lismore in an area periodically visited by Inspectors, 927 cases of Bunchy Top, several at least six months old, were found in one ten-acre field and an eradication order was the only course possible.

Considerable attention was given by the writer to the methods of diagnosis of this disease, particularly in the early stages. In Australia, the onus of periodic inspection and action is on the individual grower who, on finding an infected plant, is required to spray it with pure kerosene so as to kill all aphides and then to dig out and destroy the whole stool. In stools four years or older where there is no connection between corms it is now considered sufficient to destroy the infected plant only—not the whole stool. This rests entirely on the discretion of the Inspectors whose areas are so organised as to permit of inspection once in every three or four months. When the disease is found to have spread to several stools, all plants within one chain of the centre of the affected area are eradicated.

There is no question, therefore, but that this very extensive industry is successfully maintained only by strict attention to the suppression of diseases and by rogueing-out infected plants as soon as found. There is no question of varietal resistance in the host or of control of the vector, *i.e.*, preventive or curative measures are out of the question. The efficacy of the regulations is seen in the results obtained. Needless to say, there is a section of the growers who chafe under the strict execution of the regulations and recently the Banana Growers' Federation in New South Wales decided to appoint its own agents to inspect and eradicate diseased plants and so take the responsibility from the individual grower.

Cercospora (Leaf Spot).—The disease caused by *Cercospora musæ* is commonly seen both in New South Wales and in Queensland, but is most serious in the northern part of the latter State. Many plantations were seen where this disease was present only in a very minor degree. There are no regulations controlling this disease as no control methods are known, and the conditions associated with it have not been completely investigated. Numerous cases of plants showing the typical collapse of "Sigatoka" disease without the presence of *Cercospora* were noted, thereby suggesting the possibility of other factors being concerned. The failure of the plants at fruiting time was not explained although it was suggested that it might be nutritional or seasonal. The tendency generally was to cut the fruit on the thin side to avoid premature ripening associated with the disease.

Mr. J. H. Simmonds, Senior Plant Pathologist, has studied this disease for several years, and, as recorded in various publications, has been unable to control the leaf spot economically by means of sprays or dusts. The writer is of the opinion that *Cercospora musæ*, although associated with "Sigatoka" disease, and indeed common in some areas not affected by that disease, is not the sole cause of the latter condition.

Cigar End.—This is a disease of the green fruit, and occurs in the plantation, particularly about the month of June, causing considerable loss as

it destroys the fruit in the green stage. A firm, dark decay commences at the apex of the fruit surrounding the dead floral parts. This rot extends back gradually for upwards of an inch. Fruit so affected is entirely useless and I saw many bunches in the plantations wholly or partially ruined by the disease. It is caused by the fungus *Stachylidium theobromæ* whose spores form an ashen coat on the lesions. In typical cases, the shrunken end of the fruit resembles a burnt cigar-end, hence the name. Control methods are not practised, but as injury to young fruit-ends may assist the disease, removal of the floral bracts and opening up of the top of the pseudostem is recommended.

Black Finger.—This disease is caused by a species of the fungus *Phoma*, and typically results in the mummifying of the affected fingers. The fingers develop a jet black decay, commencing at the tip, and finally the whole finger dries up and resembles a mummy.

Panama Disease.—One of the most valuable aspects of the writer's visit to Queensland was the opportunity to investigate this disease at first-hand in the field: and through the kindness of Mr. Simmonds, Senior Plant Pathologist, it was possible to make a particular study of the symptoms and diagnosis of this disease. In New South Wales and Queensland, it is confined to the taller varieties such as Lady's Fingers, Sugars, Gros Michel and certain plantains which are usually grown on the rich alluvial flats near the main centres. There is a fair local demand for the fruit of the first two varieties, the flavour being considered superior to that of Cavendish.

The disease is the typical wilt associated with *Fusarium cubense* and is generally marked (Fig. 8) by the yellowing of the leaves, the collapse of the leaf stalk and the drying out of the leaves. The internal symptoms are unmistakeable, the disease being localized in the vascular strands which are discoloured red, or yellow-brown. Plants at all stages are affected and although in some ways with results similar to those found in "Sigatoka" disease, it is impossible to confuse the two conditions. From a great number of careful observations made, it is concluded that the main disease of commercial varieties in Fiji in not Panama disease although it will be necessary to check the identity of disease in some of the plantain varieties. Cavendish and Veimama varieties in Australia are not subject to Panama disease.

Several plantations in different localities were seen where Cavendish and Veimama varieties were affected with a similar disease to "Sigatoka" disease (bunch stalks broken, &c.) and where *Cercospora musæ* was certainly not present. These fields bore a similar aspect to diseased plots in Fiji except that the soil was clean-cultivated.

Yellow Leaf Spot.—This leaf spot of banana is serious only in the northern parts of Queensland and is caused by the fungus *Cordana musæ*. Severe defoliation has been experienced in Queensland.

The following diseases were also investigated, and all available information noted:—"Leaf-fall," (Fig 9) a nutritional disorder which responds to suitable fertilizer treatment; "Dry-rot" of the corm caused by *Poria* sp.; "Corm rot," caused by *Clitocybe*; "Heart-rot," a destructive virus disease marked by the decay of the funnel leaf and the heart of the plant; "Speckle," a leaf disease of wide distribution; "Gumming" of immature fruit; "Black Pit"; "Black End" or "Fruit Stalk Rot"; Anthracnose and Squirter.

Of the above mentioned diseases, the most noteworthy are "Anthracnose" and "Squirter," both of which affect the market quality of the fruit.

Squirter.—This is a disease of transported fruit caused by the fungus *Nigrospora sphærica* which develops on leaf-bases, bunch-spathes and other

dead banana material in the plantation whence infection proceeds to the fruit. The fungus gains entrance through the broken end of the finger stalk and develops in ten days to decompose the pulp of the fruit into a dark, semi-fluid state. During my visit the trouble was most severe in fruit from certain plantations in northern New South Wales. Control measures include sanitation methods in the plantation and packing sheds:—packing in clusters and bagging bunches during winter months.

Anthracnose.—This is also a fruit disease characterized by sunken lesions which form the unsightly blemishes characteristic of Cavendish and Veimama fruit in the ripening stage. The initial infection is in the plantation (a fact which has been already recorded in Fiji) and the presence of the organism results in a hastening of the overripe condition. The causal organism is *Glœosporium musarum,* and research is in progress both by the State Department and by the officers of the Council for Scientific and Industrial Research into the question of control measures. Careful handling of the fruit at all stages to avoid bruising is considered extremely important. The fungus is always present on dead leaf-bases and it has been found that trashing of plants results in less trouble from Anthracnose and Black End.

Pests of bananas.—The main causing damage to bananas in Australia are weevil borer (*Cosmopolites sordidus*); thrips (*Scirtothrips signipenis*) causing rust; fruit-eating caterpillars (*Tiracola plagiata*); banana fruit fly (*Chætodacus musæ*); aphis (*Pentalonia nigronervosa* and red spider.

Weevil borer is kept in check by strict selection of clean suckers for planting and by systematic poisoning by means of traps. In all plantations visited, the poison-bait traps were seen; and generally speaking the damage caused by this pest sppeared to be slight owing to the efficiency of the control measures.

The banana thrips is responsible for a serious skin condition known as " rust " which impairs the quality of the fruit and renders it unmarketable. Strict attention is given to plant sanitation, selection of clean suckers, proper trashing and removal of all plant debris in the field and to cultivation.

Fruit-eating caterpillars cause blemishes similar to " Scab " in Fiji which is caused by *Nacoleia octosema,* but the amount of damage is very slight indeed. Nowhere is it necessary to dust the bunches as in Fiji, and one of the most striking aspects of banana culture in Australia was the absence of any need for care in this respect. The complete freedom from scab was the rule rather than the exception.

The banana fruit fly is a pest of some importance in the northern parts of Queensland.

The aphis is, as previously mentioned, the vector of Bunchy Top virus, and was present in all plantations in enormous numbers. The rapid spread of this disease is no doubt due to the extreme abundance of the vector on all plants. Direct control of the aphis is not considered practicable.

Banana Varieties.—The main commercial varieties in both states are the Cavendish and the tall strain known locally as " Williams Hybrid." It was of interest to find extensive plantations of excellent " Veimama " bananas in both States. During 1928, New South Wales imported a supply from Fiji and from these and from earlier importations *via* Queensland, some 20 acres of this variety are being grown in the Tweed River districts and an increasing demand for suckers is noted. In South Queensland, over 500 acres of this variety have been planted in the past two or three years and some of the finest stands are in this locality. The variety is known locally under a number of names:— Vernon, Mons Marie (Fig. 3) Gros Michel, &c.— but there was no doubt of their identity with the Fijian Veimama. The

history of some of the plants was known and it was possible in several cases to obtain corroborative evidence as to the origin of the plants. In these cases they were traceable to importations from Fiji during the past 30 years. Both the short and the tall types were seen but the majority were of the short to medium type.

The New South Wales Departmental Variety Plots were of great interest and the " Veimama " propagated from the 1928 importations were in excellent condition and producing splendid bunches.

The establishment of this variety in Australia is of considerable interest for the following reasons:—

(1) The fact that it is a Fiji variety permits the fruit to be sold in Sydney and Melbourne as " Fiji " bananas.

(2) Investigations in New South Wales tend to show that the variety is tolerant to Bunchy Top virus, *i.e.*, that it is able to grow out of the condition. This particular point is being studied intensively by Mr. Magee, Plant Pathologist, New South Wales Department of Agriculture, and plants known to have been infected with the disease were found to be growing normally in the experimental plots.

(3) The fruit produced by this variety compares very favourably in size, quality and flavour with that produced in Fiji and its increasing popularity among growers and the increasing supply available are factors which would have to be reckoned with in the event of any renewed attempts to place Fijian bananas on the Australian markets.

Other varieties noted in the Variety Plots at Tomewin, New South Wales, where the Department of Agriculture has examples of many varieties, collected locally and in South Queensland, include:—Gros Michel; Williams Hybrid (Giant Cavendish); Veimama, both local and Fiji strains; red Petiole G.M.; Loburn:—Plantain; Mons Marie; Pear; Red Rajah; Sugar; Improved Sugar; Blue Java; Vernon: (Veimama); Weeping Cavendish.

In Queensland, the following additional varieties were seen:—Lady's Finger; Red Dacca and a possible variant known as " Clarets's "; Colombo; Common Plantain; Lubin: (Booka Booka); Rajah (White Dacca) and Andalusian.

Of these varieties, the most important are Cavendish and its variant, known locally as " Williams Hybrid " ; Veimama, known locally as Mons Marie; Vernon; Gros Michel; and often confused with Williams Hybrid; Sugar, a very popular variety for local markets; Lady's Finger, also popular; Golden Gros Michel and Weeping Cavendish which is a very distinct type.

In many districts there is much confusion of names. A plant which is not obviously a true Cavendish may be called " Gros Michel " or any of a number of other often local names. Both State Departments have recently undertaken special observations of the banana and plantain varieties grown in Australia.

In the past, little work has been done in either State on the question of varieties but recently the need for definite knowledge of the characteristics of all strains has been recognised; varietal plots have been established and collection of data commenced. The New South Wales Department has recently imported some suckers of the Hybrid I.C.2. from Trinidad.

Ripening Methods.—In Brisbane arrangements were made to visit the fruit markets to study ripening methods employed by various firms and institutions such as the Committee of Direction for Fruit Marketing, which is

a Growers' organization, which has recently installed a most up-to-date electric ripening plant.

In the markets were to be seen large quantities of Lady's Finger, Sugar, and Cavendish, with some Mons Marie—which was generally considered a local sport of Cavendish.

In the electrically-controlled ripening rooms cases only were handled, 1,850 cases being a full load; the weekly out-put is 2,000 cases. The temperature is brought to 68°, and ethylene gas introduced two or three times a day. The humidity is controlled at 85 per cent. until the fruit springs (in 1½-2 days) when it is reduced to 75 per cent. The temperature is never raised above 70° otherwise keeping-quality is affected while if it falls below 60° the flavour is spoiled. After springing, the stages are:- - colour show (2½ days), full colour (5 days). The fruit is usually sent out to retailers at the colour show stage depending on the weather. The gas concentration is 1 : 1,000. Artificial ripening is claimed to be necessary as in ordinary temperatures and humidity the fruit might not ripen or ripening may be very irregular. Ordinary ripening is not satisfactory in mid-winter and mid-summer.

At the time the writer's visit, Anthracnose was not developing as the weather was very dry. Black End is a common disease of ripening fruit, due to the breaking-up of hand into singles resulting in the injury of finger stalks. In February, 1936 he was informed that premature ripening of Cavendish was very markedly associated with Anthracnose.

It appeared that in some instances Australian fruit was being auctioned in the markets as " Fiji bananas," and the merchants considered that Fiji should protect herself against such action by maintaining a small, regular, well-graded shipment of fruit to Sydney.

GENERAL NOTES.

Some additional notes on the Banana plantations in south Queensland may be made. In the Carrumbin Valley (Fig. 7) there are now 1,000 acres under bananas. In 1921–1923 bananas in this area were exterminated by Bunchy Top virus and replanting commenced in 1929. Most of the land is held on lease at £4 per acre, the first year being rent-free. During the past six months, a total of 500 acres has been eradicated under the Regulations of the Banana Protection Board. At Talleyrageba, one Company has planted 100 acres in one block and intends planting another 100 acres in 1937.

The soil in the Carrumbin Valley is a clay loam, covering very steep hillsides. This soil is very friable and in many cases erosion has been severe. Nevertheless, growth of the plants is splendid and many excellent stands were seen. A recent development has been the utilization of grass land for bananas. On one of these plantations the growers cut £125 worth of bananas in six weeks from a three-acre field. Pruning is regulated so as crop in winter when prices are good. The bunches seen were splendid, there being no evidence of " choke throat " and the ground was thinly covered with banana trash. A manurial experiment was being carried out by the Agricultural Department. Excess of potash was found to cause suppression of suckers. Sulphate of ammonia gave large bunches with small fruit. The soil conditions were reminiscent of those prevailing in Vatulele Island, Fiji, and were probably alkaline in reaction. Only two Bunchy Top plants has been found in this plantation. From 75 per cent. to 80 per cent of the fruit was packed as " eights," the premier grade of the market.

At Austinville, 50 farms were opened in 1933 for relief workers in rain-forest country, the rainfall being approximately 60 inches per annum and the altitude about 800 feet above sea-level. The best farms were very stony, clean weeded by hand-pulling and all plants cleanly trashed (Fig. 6). There was no " Leaf spot," and on one farm, out of 900 cases packed, only one was of " sixes " grade. Pruning aimed at one main plant and one sucker.

The plants (Cavendish) were 8 feet high with stems 16in. -18in. in diameter, and bunches of up to 16 hands; 54 bunches packing 35 cases. Here the average cost up to bearing was stated to be £40–£50, the average maintenance £20 and average return 70–100 cases per acre.

Many excellent wire-conveyor systems were seen here and elsewhere and rough sketches made. Pruning implements also were studied as well as case-presses and other apparatus.

RECENT ADVANCES IN THE COOL STORAGE TRANSPORT OF FRUIT.

By

B. E. V. PARHAM,

Agricultural Officer Central (Plant Pathology.)

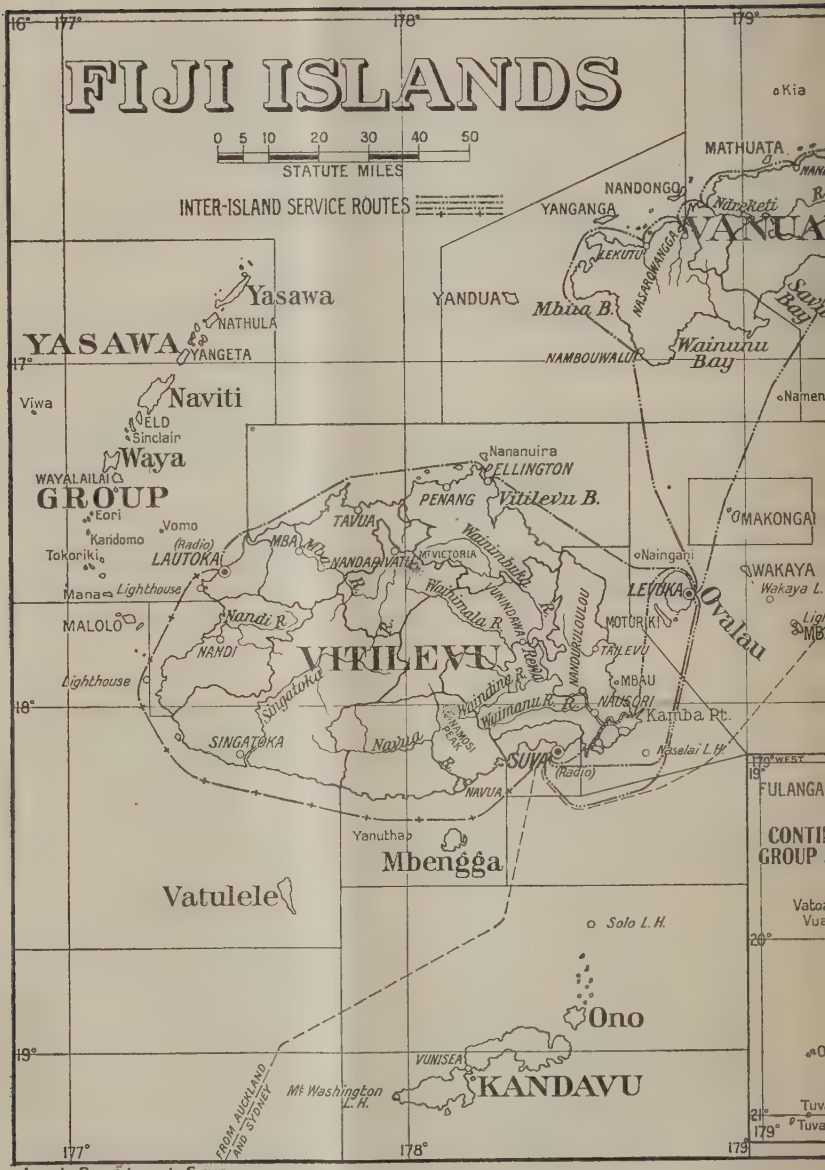
THE remarkable development of meat and fruit-producing countries as a result of the invention of modern refrigeration methods—enabling the transport of perishable freights over long distances without loss—is a feature of the last decade of agricultural history.

It is not generally realized, however, that the regular successful transport of fruit across half the world has been achieved only in comparatively recent years as the result of long and careful research and investigation both in the producing countries such as South Africa, Australia and New Zealand and also in the marketing countries, Britain, Germany and others. Most of this work has been done during the past ten years as the result of heavy losses in fruit cargoes and a brief survey of the problems encountered and the results achieved may be of interest.

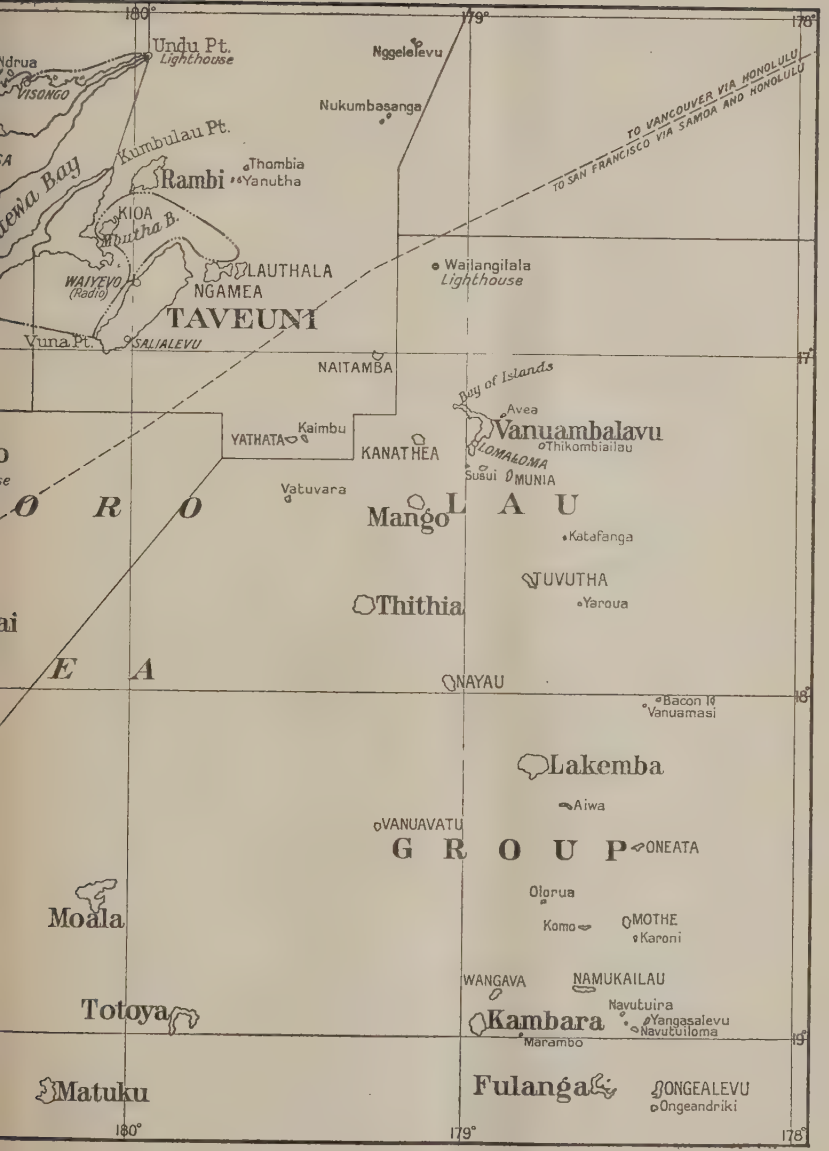
The difficulties of fruit storage are due to the fact that the fruit is a living organism, the tissues of which are still actively functioning during the whole period of transport. The normal processes of respiration and of chemical changes associated with the natural onset of ripening cannot be stopped without injury to the tissues; and the aim of fruit refrigeration or cool storage is to retard those processes for the required period. Any consignment of fruit has, therefore, a definite potential period for cool storage beyond which deterioration and decay inevitably set in.

The diseases of fruit in cool store may be grouped under two headings, viz., (1) the primary or so-called physiological diseases which are caused, not by fungi or bacteria, but by interference with the life-processes of the fruit and (2) the secondary diseases resulting from the growth of fungal and bacterial contaminations originating in the orchard and plantation. Of the former class are internal breakdown or tissue-collapse and the various scalds; among the latter are the common rots associated with the blue and green moulds, the anthracnose fungi and other organisms whose spores may be found in abundance on the surface of fruit, in the air of packing sheds and orchards and on the gloves and hands of packers.

In the case of temperate climate fruits, such as apples and pears, the problems of cool storage were found to involve a study of many factors both before and during the actual process of storage. It has been found that the storage quality or capacity of fruit is influenced by the method of planting, manuring, cultivation, pruning, harvesting practice, climate, &c., and that different varieties demand different cool storage treatment.



Lands Department, Suva.


180°
179°
178°
Undu Pt.
Lighthouse
Nggelelevu
Nukumbasanga
TO VANCOUVER VIA HONOLULU
TO SAN FRANCISCO VIA SAMOA AND HONOLULU
Kumbulau Pt.
Thombia
Yanutha
Rambi
KIOA
Yanutha B.
WAIYEVO
(Radio)
LAUTHALA
NGAMEA
TAVEUNI
Wailangilala
Lighthouse
Vuna Pt.
SALIALEVU
NAITAMBA
17°
Bay of Islands
Avea
Vanuambalavu
Thikombiailau
YATHATA
Kaimbu
KANATHEA
LOMALOMA
Susui
MUNIA
Vatuvara
Mango
L A U
Katafanga
UVUTHA
Yaroua
Thithia
NAYAU
Bacon Id
Vanuamasi
18°
Lakemba
Aiwa
VANUAVATU
G R O U P
ONEATA
Olorua
Moala
Koma
MOTHE
Karoni
WANGAVA
NAMUKAILAU
Navutuira
Totoya
Kambara
Yangasalevu
Navutuiloma
Marambo
19°
Matuku
Fulanga
ONGEALEVU
Ongeandriki
180°
179°
178°

Temperature, humidity and ventilation are most important factors and each variety of fruit has its own particular requirements in these respects. Stage of maturity, delayed storage, soil type, manuring and in the case of budded trees the influence of root-stocks are all of great importance in determining the storage behaviour of the fruit.

While temperatures may not be low enough to cause actual freezing injury, they may still be too low to permit of normal biological processes. Very high humidity in the store air is deleterious and lack of ventilation causing accumulation of the carbon dioxide of respiration to concentrations above 10 to 12 per cent. may result in the suffocation of the fruit.

Immature fruit may develop excessive shrinkage but overmature fruit, *i.e.*, fruit in which the ripening processes are well advanced, cannot be held satisfactorily in cool storage. Pre-storage delay between harvesting and storage, is the source of increased storage troubles—both of a primary and a secondary nature. Generally speaking manuring has also a definite effect, often over a long period of time, on the keeping quality of fruits, thus, apples from trees heavily manured with ammonium fertilizers developed excessive storage breakdowns for several years after the application of manure and bananas grown in heavily-manured soil rapidly deteriorate in storage.

In the case of tropical fruits, investigations have in recent years been undertaken, principally so far as the British Empire is concerned at the Low Temperature Station established by the Empire Marketing Board at the Imperial College of Tropical Agriculture, Trinidad.

This Station was erected in 1930, at a cost of approximately £5,800, for the study of cold-storage transport of bananas; but has since then conducted many and importants investigations into the cool storage of other tropical fruits and vegetables such as tomatoes, avocado pears, pawpaws, citrus fruits, &c. As regards bananas, the principal problem has been the determination of the " precise set of conditions suitable for the successful transport overseas and subsequent ripening to an attractive yellow colour " (1) of banana varieties resulting from the plant breeding experiments at the College. Owing to the prevalence of Panama disease to which the main commercial variety (Gros Michel) of the West Indies is highly susceptible a concerted attack has been made during the past 10 to 12 years on the problem of finding a substitute which will conform to all the requirements of the Trade.

The banana is usually harvested quite green, periods of cool storage transport are relatively short (12 to 20 days) and the temperature is in the vicinity of 53° to 56°F.

The fruit is ripened in special rooms at a temperature of about 70°F. and marketed immediately.

The main problems therefore are the determination of " the correct stage of maturity at harvesting, and the precise conditions during transport and subsequent ripening which will ensure the product reaching the market in a neat and orderly bunch of attractive colour."(2).

Provided careful control of temperature, humidity and ventilation is seen to, in accordance with the individual requirements of the particular variety being handled, the green banana is not a difficult subject so far as the refrigeration biologist is concerned.

The main secondary storage diseases of the banana in various countries are as follows:—Australia—anthracnose, squirter, black-end; West Indies—anthracnose, stem-end rot, cushion and main-stalk rots; Fiji and Samoa—anthracnose, black-end and main stalk rots, &c.

All of these conditions are the result of infections or contaminations by

fungi originating in the orchard or packing shed and developing subsequently on the ripening fruit.

Anthracnose is the well-known black spotting of the fruit with a depressed centre, " squirter " is a condition practically confined to Australia, while the other rots are common in all banana cargoes.

Both " squirter " and Anthracnose have been much reduced by attention to plantation hygiene; recent work in Australia by officers of the Council of Scientific and Industrial Research showing that trashing, *i.e.*, removal of dead banana leaves in the plantation, resulted in a marked reduction in infection by the causal organisms.

Main-stalk rots—often a feature of bunch cargoes—have been satisfactorily controlled by sealing the clean cut end of the bunch with vaseline immediately prior to shipment: and as black end has been proved to be associated with the packing of " singles," steps have been taken in Australia to encourage the packing of hands and clusters rather than of single fingers. Among the obvious main sources of storage trouble are rough handling, bruising and pre-storage delay. It will be readily understood that, particularly in tropical countries, exposure of fruit charged with spores of rot organisms in an atmosphere of high temperature and humidity cannot but result in increased susceptibility to storage rots. The development of these may be somewhat retarded in cool stores but as it takes many hours to bring heated fruit down to correct carrying temperatures much damage frequently results from this cause alone.

Citrus fruits are liable to a host of transport diseases and it is significant that most of these are the direct result of injuries received during harvesting and handling. The majority of rot-producing organisms are wound parasites, *i.e.*, they attack the fruit only through wounds or injuries, which may be extremely slight and quite invisible to ordinary sight.

It has also been found that the presence of one wounded over-mature or infected fruit in a case is sufficient to accelerate deterioration of the rest of the fruit, probably owing to the development of ethylene gas.

Wrapping papers steeped in sterilizing solutions have given useful results in some cases by rendering the spread of rots from fruit to fruit more difficult, but the best results have been obtained by attention to harvesting and handling methods.

In a country such as Fiji, where shipping facilities provide opportunity only for periodic shipments of fruit, the questions of pre-storage delay and the reduced handling and bruising of fruit is of paramount importance.

There is no doubt that the solution of the problem of transport wastage is bound up with the provision of pre-cooling facilities and it is considered that in the Australasian–South Pacific sphere ultimate success as a tropical fruit-exporting country must go to the region which is first in the field with adequate provision for the pre-cooling and holding of harvested fruit for the necessary period of a few or more hours immediately before shipment. The value of such facilities may be recognised also in the possible saving of a great quantity of fruit which matures between shipments and in the opportunity they provide for successful transport of the more perishable classes of fruits as pawpaws, avocado pears, custard apples, &c., for which an increasing demand may well be expected in southern markets. In this connection it is interesting to note that steps have been taken for the establishment of a pre-cooling plant at Rarotonga in the Cook Islands, the sum of £25,000 having recently been allocated for that purpose.

(1) Wardland, C. W., and McGuire, L. P.—1932. *Empire Marketing Board Bull.* No. 60.
(2) Wardland, C. W., and McGuire, L. P.—1933. *Empire Marketing Board Bull.* No. 72.

THE WILD TAMARIND.

(*Leucaena glauca* Benth.)

By
W. L. PARHAM,
Agricultural Officer, East.

In a recent article (1) entitled " Soil Erosion," Jack mentions " counteracting shifting cultivation such as is practised in Fiji . . . . by providing a good rapid growing cover when land was thrown out of cultivation."

A present major activity of the Department of Agriculture is the encouragement of Fijian small-holders but concern is being felt about the maintenance by a people accustomed to shifting cultivation of soil fertility on their small-holdings.

During a recent tour of the upper valley of the Ba river the writer was again impressed by the extensive areas under *Leucæna glauca* Benth, locally known as " Vaivai," and by the evident value of this tree in prevention of soil-erosion and in improvement of soil fertility.

As stated by Sykes in *The Forests of the Colony of Fiji* (2) this tree " regenerates prolifically, grows rapidly and coppices vigorously." It is rapidly becoming a dominant of the dry zone uplands as observed by the writer on Viti Levu in Colo North, Ra, Nadi, Lautoka and Colo West.

The tree is recognised generally in the literature of tropical agriculture as an improver of the soil and the Fijians now regularly seek out " vaivai " thickets for the sites of new gardens which when abandoned revert rapidly to thickets.

The preference of *Leucæna* for river banks and gullies, combined with its habit of growth, give observable results in the prevention of erosion. Its deep and tenacious root-system prevent it becoming a danger as driftwood in abnormal floods. For instance, after the 1931 flood the writer observed for miles along the upper Sigatoka and the Draubuta Rivers that " vavai " had been swept to the ground but not-uprooted.

Sykes (2) states further " In the Philippines it has been used for afforesting grass lands to pave the way for the introduction of timber trees."

In Fiji the value of " vaivai " as firewood is well known and it is utilised by Indians and Fijians in house-building.

To sum up, in *Leucæna glauca* we have a tree which with the minimum of human intervention promises to solve in the dry zone the allied problems of prevention of soil erosion and the maintenance of soil fertility.

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(1) Jack, H. W., 1937. *Agricultural Journal*, Fiji, No. 4, Vol. 8.
(2) Sykes, R. A., 1933. Council Paper No. 9, Fiji, p. 45.

NOTES ON CULTIVATION OF SEA ISLAND COTTON.

By
LYON-FIELD, A.M.I.E. (India),
Agricultural Officer, North.

The cultivation of cotton is not by any means new to Fiji as it was grown during the American Civil War. The industry was resuscitated in 1923, with the view of giving the Indian peasantry a cash crop and it made reasonable progress until the depression set in, in 1931. In 1926-27 the maximum crop produced ammounted to nearly 1,000 bales. From then onwards the crop decreased rapidly which may be attributed to over-production in the West Indies of the variety chosen here-Sea Island—and to the depression years.

Efforts have been made by the Department of Agriculture to produce a cotton to suit the climatic conditions of Fiji and one for which there would be a constant demand, the demand for Sea Island fluctuating very considerably. So far, creditable results have been obtained by the new Fiji Hybrid No. 172; but sufficient quantity has not yet been produced to enable its real market value to be proved. Experiments are still being made with it by one mill only which in March, 1937, paid 15d. per pound for it. This proves its remunerative value as the cotton returns a very good aggregate yield, with practically half the labour cost of Sea Island. Until sufficient quantity of this Hybrid has been produced to put on the market on competitive lines it is deemed wise to continue with the Sea Island variety.

CULTIVATION OF SEA ISLAND COTTON.

In Fiji, no hard and fast rules can be given for the spacing and thinning out of the cotton plants which are grown by Indian peasantry and by Fijians. The Indian peasants, who are settled on small holdings in the foothills, seldom plant more than one acre. Their lands vary greatly in fertility, consequently there is no uniformity of soil as is found on sugar estates in Fiji and some of the West Indies. Climatic conditions have also to be taken into account, as the rainfall increases from the south-west coast of Viti Levu (Nadroga) across the foothills to the mountains, a distance of less than ten miles.

Rainfall and humidity play an important part in the spacing and thinning of the Sea Island cotton plant. Therefore it is advisable for each grower to carry out spacing and thinning tests over a series of years to obtain the best results on his own particular piece of land; as a general rule however, it has been found that a spacing of 3ft. x 5ft. gives satisfactory results.

Spacing.—On rich land similar to Bila land *i.e.*, river flats, spacing 5ft. x 6ft., five feet between the plants and six feet between the rows, is recommended when planting from the middle of October to the end of November; from then to the end of December close up the spacing by a foot each way; and during January to end of February close up by a further six inches each way. On second class land, spacing should commence from 4ft. x 5ft. from the middle of October to the end of November; from then onwards to the end of February continue to close up the spaces by one foot and then by six inches as stated above for rich land.

Thinning out.—Plants should be thinned when five to seven inches tall, leaving two plants to each site; on second class and poorer soil however, after December, only one plant should be left. Unless this thinning out is done plants will grow spindly and tall which causes fewer lower fruiting branches and, in consequence, a later maturing crop. Also, during the heavy rains, much damage will be done as the tall spindly plants will be bent down and become interlocked with one another across the rows thereby making cultivating and harvesting more difficult and costly; also it encourages boll-rot and fungal diseases. With the Sea Island plant it is most essential that the maximum amount of light and sunshine should penetrate the rows, and this applies more especially to crops planted before the end of December.

Soil.—Cotton will grow on any deep well-drained soil, from heavy to light loams such as where maize grows well.

Preparation.—Plough and cross-plough to a depth of seven to nine inches. This ploughing should be done two months before planting.

Planting.—From the middle of October to the middle of December is the best planting period. Plant three to four seeds in the same hole not more than two inches deep. Ground must be well harrowed and worked to a medium tilth to conserve moisture and kill weeds—a fine tilth is not necessary. Early planting from October to the end of November should be done in the furrows; from then onwards plant on the hills.

Cultivation.—The young plants will usually appear in from six to ten days, though seeds have been known to remain ungerminated under dry conditions for more than six weeks and then produce a good strike. Cultivators in Fiji frequently wait until too much rain has fallen and lose the best planting period. They fear planting on an inch to inch and a half rainfall although this is ample.

Cultivate early and often to kill weeds and conserve moisture. The quality of the lint depends largely on good cultivation; and, as price depends on quality, cultivation is a good investment to the grower. In cultivating, gradually work the soil towards the plants to form hills. Cultivation should cease when flower-buds begin to form.

Picking.—Pick clean, try and avoid leaf-dirt, sticks and stainy or diseased cotton as all these lower the grade. The strictest care should be exercised to keep the seed-cotton free from foreign matter of any description. Stained, unripe and dead locks should not be mixed with clean sound cotton.

Cotton picked with the dew on, after a shower or before moisture has been dispersed, must be spread out in the sun and thoroughly dried before being bagged or stored in heaps.

Cotton picked early in the morning with a dew or with a high humidity is much cleaner and easier to pick than on very dry days, as it pulls easier and far less dead leaf and trash will be mixed with it. Leafy or pepper cotton—that is, cotton with a lot of small, dry leaf-specks in it looking like coarse pepper—lowers the grade very considerably. Spinners have to remove it by machinery—a costly and wasteful process. In fact all cotton should be picked and kept as clean as possible as there is no sense in shipping away dirty, leafy and trashy cotton and paying 1½d. per pound to carry dirt to England.

Keep your cotton clean and get a higher price for it. And it is not to be overlooked that Sea Island cotton cannot be treated in the same rough way as a short and medium-stapled cotton, *i.e.*, by passing the seed-cotton through cleaning machines and openers, as this process damages the staple.

THE SHOT-HOLE BEETLE BORER OF AVOCADO PEAR TREES.

By
R. J. A. W. LEVER.

In 1934 Paine (1) recorded the attack in 1931 on Taveuni Island of avocado pear trees by the shot-hole borer, *Xyleborus morstatti* Hag. In 1933 he found this bettle to be severe enough to threaten the life of some trees at Waitavala and in October 1937 the present writer saw the beetle in tolerable abundance both at this estate and the next. In January, 1938, he took specimens at Suva on Viti Levu, the first record for the main island and rather a bad omen for growers of this tree.

This insect measures 2mm. (say, one-twelfth of an inch) in length, has a brown head and thorax and black wing cases and so is known in the East Indies as the black twig-borer. Its usual host is coffee bushes but it has been recorded also from mahogany, oil palm, coca (*Erythroxylon*), and elder (*Sambucus*). Its recorded distribution besides Fiji is East and West Africa, Madagascar, India, Indo-China, Sumatra, and Java. Paine (*loc. cit.*), says

it " appears to be a native of East and West Africa where it is not known as a pest "; however, as a species of *Tetrastichus* is recorded as a parasite from Java and even so far back as 1913 references (2) show the borer to have been harmful in German East Africa, it is more likely to have spread thence from the East Indies and Malaya where at least ten species of the genus are known.

The sketches of the egg, grub and adult (the last shown enlarged) and of a typically damaged twig should enable the owner of avocado pear to recognise if this insect is present. The entrance hole looks as if it were made by gun shot or a fine auger, hence the name of shot-hole borers given to these Scolytid or Ipid bark beetles which are related to the weevils. Around the hole is a white powder which is a reaction product of the tree in response to the injury; at first glance it resembles mealy bugs.

The following control measures are recommended; several are given as not all the ingredients required may be present on the plantation:—

1. Paint the mixture, made up of the accompanying ingredients, on the branches:—

    1 lb common laundry soap,
    ½ pint crude carbolic acid,
    3 gallons water.

2. Alternatively, apply the following mixture with a brush:—

    1 part of petrol or crude oil,
    6 parts of axle grease.

3. Paint Bordeaux mixture made adhesive with resin and soap.

4. Cut off badly affected branches and destroy thoroughly by burning. Large branches should have their cut surfaces painted with asphalt paint diluted with petrol or with coal tar. This pruning of bored branches is most important.

5. A fine probe of flexible wire can be inserted into the entrance hole to kill the various stages (there may be up to six grubs) in the excavated area wihin, and one of the solutions above then applied.

6. As trees often respond to a fertilizer, tests should be made on a few of them by applying 3 lb per tree of sulphate of ammonia or nitrate of soda. Caution, however, is advisable with such nitrogenous fertilisers as they tend to give vegetative growth at the expense of fruiting wood and a consequent lower yield.

Records of new localities will be of interest to the author as it is important to know if this borer is continuing to spread locally.

The writer is obliged to the Agricultural Officer, Islands for his help with the preparation of sketches.

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(2) Hagendorn, M., 1913.—*Der Tropenflanzer*, XVII.

SOME INSECT PESTS OF THE TAHITIAN CHESTNUT.

By
R. J. A. W. LEVER, B.Sc. Hons., D.I.C., A.I.C.T.A., F.L.S.

During December 1937, and January 1938, caterpillars were found boring inside fruits of the Tahitian chestnut (*Inocarpus edulis* Forst.) whose kernel is a not unimportant source of food to the Fijians who call these trees "ivi." Fruits were collected by the writer at Suva Point and were also forwarded to him by a resident at Muanivatu with a request for control measures.

The caterpillars, which are white with light black spots on each segement, were reared in the laboratory and proved to belong to the Tortricid moth *Cryptophlebia* (*Argyroploce*) *illepida* Butl. which has chocolate to cinnamon coloured forewings with paler curved lines and a wing-span of an inch to an inch and a quarter. This insect is known from South Africa, India, Australia, S. China and Hawaii and has the popular names of Queensland nut-borer, litchi fruit-borer or false codling moth. Besides *Inocarpus*, *Macadamia* (Queensland nut) and *Nephelium* (litchi), it has been recovered from pods of *Acacia* and *Bauhinia*, the last-named being the "butterfly tree" with purplish-pink and white flowers which grows at the western end of Cakobau Road.

Three Hymenopterous parasites are known from Hawaii, viz., the Ichneumon *Cremastus hymeniæ* Vier., the Bethylid *Perisierola emigrata* Rohw. and the Braconid *Microbracon pembertoni* Brid. It is of interest to note that the first of these was introduced from Hawaii into Fiji in 1928 in hopes of controlling the banana scab moth, *Nacoleia ocatasema* Meyr.

Local parasites are three in number, viz., a species of *Winthemia*, a Tachinid fly; two Braconidæ, the smaller one being a species of *Apanteles*. The larger is dark brown in colour, the legs and ovipositor being olive-green.

The chrysalis of *Cryptophlebia* is provided on each segment with a row of fine hooks, those at the apex being stout spines by whose means the pupa forces its way through the skin of the fruit so that it partly protrudes before the emergence of the moth.

As the ivi tree grows to a great height it was recommended to spray those fruits which could be reached with the following repellent solution:—

Lead arsenate	¼ oz.
Bordeaux mixture	12 gallons.
Linseed oil	1 gill.

Further, it was suggested that fallen fruits which were not wanted should be burned and those which were required for food should first be plunged into boiling water to kill the caterpillars and pupæ within. As the caterpillar eats the kernel it is advisable to collect the fallen fruits as quickly as possible for treatment.

Another insect reared was the common fruit-fly, *Chætodacus passifloræ* Frogg. The majority measured only 5 mm. as against the more usual 7 mm. from softer fruits which probably provide a more nutritious diet for the maggots than the harder ivi. Simmonds* was the first worker to give this as a host-plant, but states that the tree is endemic to Fiji though actually it occurs through Malaysia and Melanesia to the Marquesas and in Tahiti—whence its popular name of the Tahitian chestnut.

A brown and black Braconid, *Biosteres* sp., was reared from fruit-fly maggots. Its specific identification is awaited from the Imperial Institute of Entomology, London.

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*Simmonds, H. W., 1935. Bulletin No. 19, Dept. of Agric. Fiji.

Fig. 8—Banana plant destroyed by Panama disease, S. Queensland.

Fig. 9—"Leaf Fall" of Banana, S. Queensland.

Even more abundant than *Chætodacus* was the house-fly like Muscid *Atherigone pœcilopoda* Bezzi; the long-legged and short-bodied Micropezid fly *Telostylinus lineolatus* Wied.; *Opogona regressa* Meyr., a small gold and brown Lyonettid moth and *Decadarchis* sp., a white and brown moth of the same family.

THREE MOTHS FROM COCONUT FLOWERS.

By
R. J. A. W. LEVER.

In a bulletin* on early nutfall by Taylor published in 1930, three small moths found on coconut inflorescences are listed as Tinæids A, B and C. As they have been identified by the Imperial Institute of Entomology for some years now, it seems desirable to put their names on record as letters are a very unsatisfactory way of recording insects.

Tinæid A, *Batrachedra arenosella*, Wlk., is the commonest of the three and its eggs are laid on the grooves of the unopened spathe. The forewings are straw-coloured with black dots and the hind wings are pearl grey. It occurs as far west as the Solomon Islands and probably extends to New Guinea.

Tinæid B, *B. atriloqua*, Meyr., is nearly as abundant as the first and is similarly coloured but darker in shade and very slightly smaller (12 to 13 mm. as opposed to 13 to 14 mm. of *B. arenosella*). Its habits, however, are quite different as the eggs are laid on the male flower-buds, never on the spathe.

Tinæid C, *Pyroderces paroditis*, Meyr., has forewings of a bright pale chocolate colour interrupted with three white bars. It measures only 8—10 mm. and the eggs are stated by Taylor to be laid on young male flowers or the fallen debris which accumulates at the base of the leaves of the palm. From this site the larvæ have been reared by the writer in the Solomon Islands, giving support to the theory of a former land connection between these two groups now separated by 1,300 miles of sea.

* Taylor, T. H. C., 1930. Bulletin No. 19, Department of Agriculture, Fiji.

GENERAL NOTES.

"DURUKA" (*Saccharum*).

"DURUKA" is the Fijian name of a reed-like plant usually found growing in swampy and lowlying places, and identified by Seemann in his *Flora Vitiensis* as *Flagellaria indica* but is really *Saccharum spontaneum*.

Its claim to popularity is based on the flower-heads which when gathered at maturity but before opening are edible, and when baked and served with a little butter, salt and pepper are known amongst Europeans as Fijian asparagus and much appreciated as a vegetable.

Until recently the plant was not cultivated, natural sources of supply having been adequate for the local market, but within the vicinity of the larger towns small plantations are now being established by Fijians to meet the increasing demand so that the following brief cultural notes therefore may be of interest and value. As already stated, lowlying or swampy land is the natural habitat of this plant, therefore in selecting a plantation site a similar location should be chosen. Under such conditions little preparation of the soil is possible but ploughing or digging should be done wherever circumstances permit, otherwise all weeds should be slashed down.

Propagation is similar to that for sugar cane and consists of planting sets of the cane, about 12 inches long, using stems with tender rather than hard buds, these being planted in holes about 12 inches apart in rows 3 feet to 4 feet apart. Where it is possible to drill the land, planting would consist of lining the drill with the planting sets 6 inches to 12 inches apart and lightly covering with soil.

Subsequent cultivation consists of weeding to prevent the young growth from being smothered until the plants are tall enough to control weed growth by their shade.

In the wet zone planting may be practically continuous, whereas in the dry zone the planting season would be restricted in the drier lands to January to June. The plant matures in about 12 to 18 months.

—H.R.S.

NOTICE.

The Department of Agriculture has at the Nasinu Experimental Station, nine miles from Suva:—

For sale:—Plants—economic and ornamental.
Pigs—Middle White boars and sows.
Poultry—Black Australorps, sitting of eggs, cockerels and pullets.

For service:—1 pure-bred Red Poll bull;
1 pure-bred Middle White boar.

Prices on application to Acting Director of Agriculture, Suva.

REVIEWS.

INFESTATION OF STORED COPRA BY BEETLES.

Enquiries have recently been made as to the identity of certain beetle grubs varying in colour from cream through brown to grey with a brown head and a pair of processes borne posteriorly. These larvæ were found in copra and were reared in the laboratory into the so-called copra " bug " or red-legged ham beetle, *Necrobia rufipes* de Geer. Information was also sought on the control of this pest which took the form of recommending a rigid inspection in the copra sheds to avoid any fragments of copra being left on the floor, behind sacks or in corners. Any copra which is stored should be thoroughly dry as if mouldy it is very attractive to the beetles. A favourite spot chosen for pupation by *Necrobia* grubs are copra sacks, so that really old ones should be destroyed and ones not in use kept in bins.

A recent paper by the Department of Agriculture, Straits Settlements and Federated Malay States* gives details of 16 beetles, 5 moths and other insects which are commonly associated with copra in Malaya. The conclusions of the three authors are that a preference is shown for mouldy coconut meat and mouldy copra and that drying must therefore be carried out to ensure that the moisture content does not exceed six per cent.

Sacks should be treated by (*a*) putting them in boiling water for two minutes, turning them inside out, cleaning and drying, or (*b*) fumigating in air-tight containers for 24 hours with carbon bisulphide, using 4lb for every 1,000 cubic feet of space.

If only good quality copra is prepared, the sacks cleaned of insects, the sheds kept clean and not used at the same time for storing rice and the copra kept in storage for the minimum period, then the incidence of beetles will be negligible. This is owing to the absence under these conditions of mould and bacteria which can only become established in deteriorated or broken-down copra: this aspect is dealt with separately by F. S. Ward who shows there is practically no bacterial development at 28°C. (82°F.), even with a humidity of 80 per cent., if the moisture content is under six per cent.

—R.J.A.W.L.

*Corbett, G. H., Yusope, M., and Hassan, A., 1937. Scientific Series, No. 20, 1937, 50 Malay cents.

CYTOLOGICAL TECHNIQUE.

During the hundred years since the discovery of the nucleus by Brown, the study of nuclear structure and function has become of increasing practical importance to agriculture.

The problems of the geneticist and the plant breeder are fundamentally concerned with the nucleus and its behaviour; and have frequently been greatly assisted by a knowledge of cytology and cytological technique.

A Bulletin* recently issued by the Imperial Bureau of Plant Genetics is designed to provide plant breeders and others with an introduction to methods of preparation which have proved to give good results.

Full details of the principal methods are given. The routine of the paraffin method is excellently described, from the critical preliminary

**An Outline of Cytological Technique for Plant Breeders*, with a Foreword by Sir A. Daniel Hall —Imperial Bureau of Plant Genetics, Cambridge. Price, 1s. 6d.

fixation to staining and mounting, the time schedules and the numerous hints on minor points being very useful.

The more direct smear method—including the aceto-carmine method and the use of standard fixatives and stains for rapid treatment—is explained and useful hints on microscope technique given.

An appendix giving formulae for twelve different fixatives and a biliography of eleven references to literature complete a paper of immediate interest and value to all those workers to whom a study of nuclear structure is essential.

—B.E.P.

EXTRACTS.

COCONUT SHELLS.

(Extract from *The New Guinea Agricultural Gazette*, Dec., 1936, Vol. 2, No. 3.)

THE products of destructive distillation of the coconut shell have been calculated experimentally and the amounts of the various products, based on 100lb of shells, are shown as follows:—

Charcoal	49·0 lb
Pyroligneous acid	2·88 gallons.
Tar	0·26 gallons.
Acetic acid (calc.)	4·68 lb
Methyl alcohol	0·07 gallons.
Crude creosote oil	0·13 gallons.

The value of pure vegetables charcoal is well known for its uses in medicinal filters, explosive manufacture, &c.

There is only a limited demand for charcoal from copra apart from its use in suction gas engines, where special scrubbers have to be provided to use it efficiently. It has two other main uses, viz., as a decolourizing agent for fluids and absorbents for noxious gases. During the Great War coconut shell charcoal was used on an enormous scale in the filling of gas respirators.

The coconut shells may form a valuable source of supply for acetic acid, creosote for wood preservation and wood spirit (naphtha) for use either as a denaturant for alcohol or in the preparation of pure methyl alcohol.

The wood tar from coconuts finds a limited industrial use, either as an insulating compound, or as a rope lubricant, but needs a good deal of refining. The percentages of acetic acid and acetone obtained from the brown aqueous distillate, known as pyroligneous acid, are considerable and a wide commercial use for these products is assured, though plenty of other sources are available.

A sample of tarry distillate produced and submitted for analysis by a local planter gave results comparable with the above.

The shell itself provides sources for fuel for copra driers, &c., and could be used as a source of power in gas engines. The hard shell has a variety of uses for the natives, and may be used as food and drinking vessels, lamps, spoons and in some countries as cups for rubber latex collection.

THE AIM OF A FORESTRY DEPARTMENT.

" Forest reserves and what then ? The answer is as follows:—To protect and maintain the forests; to survey existing resources of various timbers and fuel wood; to obtain an appreciation of the various types of vegetation; to study the silviculture of the more important species; to further the utilization of as many species as possible and to improve the marketing thereof; to investigate the possibilities of wood preservation and anti-termite devices; to prepare plans of management for various areas so that work may proceed smoothly and consecutively over the long periods necessitated by the rate of growth of trees.

" Such is the aim of a Forestry Department."

—Conservator of Forests, Gold Coast, 1937.

FOREST PROBLEMS.

THE following remark will be of interest locally, though it appears in a Tanganyika report:—

". . . . . The anomaly, hard for the layman to grasp, is that luxuriant forest can exist on an essentially poor soil; that the naturally low fertility is largely lost when the forest is felled; and that the soil is deficient even in reserves that might provide fertility in future."

—Acting Director, East Africa Agricultural Station, 1937.

FOOD FOR THE WISE.

(Reproduced from the London *Daily Sketch* of 14/3/37.)

A GREEN-TIPPED fruit that is rather indigestible ?

You're wrong.

A golden, brown-speckled fruit that is full of health-giving foods ?

Your're right.

For a ripe banana is the highest of all fresh fruits in caloric value, giving the remarkable total of 460 calories per pound.

Which in a simpler language, means that bananas are very good for you indeed.

WHEN YOU'RE TIRED.

Unripe bananas, it is true, contain starch. But in ripe bananas this starch turns into natural glucose—the most energy-giving of all foods, and the most quickly absorbed into the system.

If you eat a ripe banana when you are tired, you'll relise the truth of this, for you'll be completely revived in a few minutes.

In fact, bananas contain, in addition to this glucose, the valuable vitamins A, B and C, as well as phosphorus, calcium, copper and iron, which, you must admit, is a great deal to find in such a simple looking fruit.

So next time you look at a banana you shoul feel a certain respect for it, since it is capable of providing you and your family with such a cheap and complete aid to better health.

IT HAS A HISTORY.

But when you relaise the wonderful possibilities of the banana, don't run away with the idea that you are of the first people to discover it.

The army of Alexander the Great ate up most of the bananas in India as far back as 327 B.C.—and, as you know, that was a pretty healthy and successful army.

40,000,000.

And since then bananas have proved themselves such a valuable food that they have been planted by grateful eaters in Jamaica, the Canary Islands and the countries round the Carribean Sea—far from their natural Southern Asia.

But after this travelling, they arrived in England only about thirty-six years ago—and now one firm alone imports more than 40,000,000 bananas every week into this country.

Which only goes to show that Britons know a good thing, even if it takes them a long time to see it.

GOOD FOR ALL.

Another grand point about the banana—it is good for every member of your family.

It is good for baby if you mash a realy ripe banana through a sieve, then mix it up with milk with an egg beater.

It is good for your school-going son and daughter, and if you give it to them with milk it will make a perfectly balanced meal. It is good for your husband and you because it gives you such readily absorbed energy.

And the same reason makes it specially good for anyone with a weak digestion. So you see, one way and another, everyone, everywhere, ought to be eating more and more bananas every day for the sake of health and happiness.

And, of course, the banana reaches you absolutely free from germs and insects because its thick skin is such a complete protection.

THE MOST INDEPENDENT MAN.

The most independent man, in any country, is the farmer who owns his own farm. To walk over his own acres gives him a strengthening feeling of independence.

He can produce most of his own food. He can always find a buyer for any product he does not need.

During a year he may not have much cash. But he has a dividend security and independence such as few people in town possess.

He can have much more cash if he studies business methods.

His success depends much more upon himself than it does upon the weather.

You may have noticed that when a man makes a fortune in a town, one of the first thing be buys with his money is a country house with plenty of land.

There is nothing else that a man can buy, in my opinion, that gives him such a feeling of strength and independence as *Land*.

As soon as a men gets a little back garden, he becomes a higher-grade man. He has a little land of his own and it almost makes a chemical change in him.

—Journal of Jamaica Agricultural Society, June, 1937.